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Verification of Impurity Removal Effect by Ion Cyclotron Wall Conditioning in KSTAR

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1. Introduction

Ion Cyclotron Wall Conditioning (ICWC) experiments have been conducted in 2012 Korea Superconducting Tokamak Advanced Research (KSTAR) campaign. Wall conditioning is essential task to make high-quality condition for plasma experiments [1, 2]. Especially, by using ICWC which is operable under strong magnetic field. The aim of paper was to investigate the effect of wall cleaning by ICWC on KSTAR. To achieve goal, the optical diagnostic systems consist of H-alpha monitors, visible survey spectroscopy (VSS) and filterscope (FS) has been utilized.

In this paper, the experiment setup, experiment results and summary are introduced.

2. Experiment setup

In this section some of the diagnostic systems used to measure are described. The visible diagnostic systems of KSTAR consist of toroidal and poloidal H alpha monitors, visible survey spectroscopy and filterscope.

2.1 Line of sight of the diagnostic systems

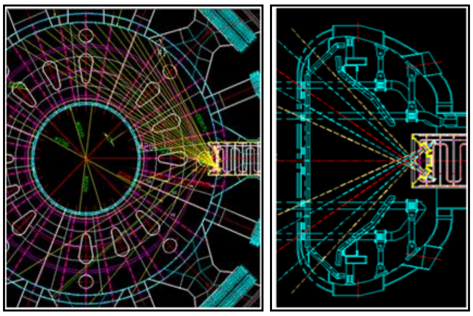

Fig.1. Toroidal and poloidal line of sight of the optical diagnostic systems

The H alpha monitor has 30 channels. The toroidal 20 channels of H alpha monitors have been arranged from edge to core because the H alpha light comes mainly from plasma edge and diverter. Channel 10 is located major radius R = 1.8m near the plasma center. Channel 12 is R = 1.6m near ECH (Electron Cyclotron Resonance Heating). Poloidal has 10 channels. Channel 2 and 7 is located in the lower and upper diverter. Fig. 1 describes the line of sight of H alpha 30 channels.

2.2 Visible survey spectroscopy (VSS)

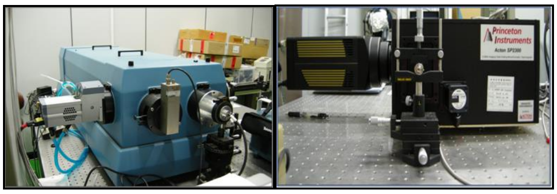

Fig.2. McPherson and PI spectrometer

The visible survey spectroscopy has 2 spectrometers. One is McPherson spectrometer and the other is PI spectrometer. It surveys KSTAR main impurity such as C(II), C(III), Cu(II), He(I) and O(II). The spectrometer system shares the line of sight with toroidal direction of filterscope.

2.3 Filterscope (FS)

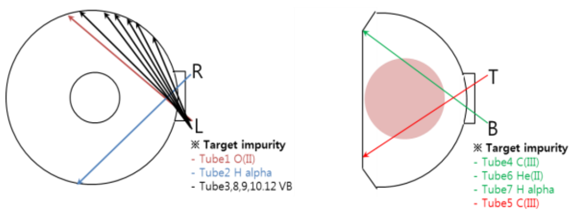

Fig.3. Filterscope line of sight

Filterscope mainly monitor He, H, C, O, VB (visible bremsstrahlung) and H alpha. It has 12 channels and the present arrangement of filterscope line of sight and direction is shown Fig.3.

3. Experiment results

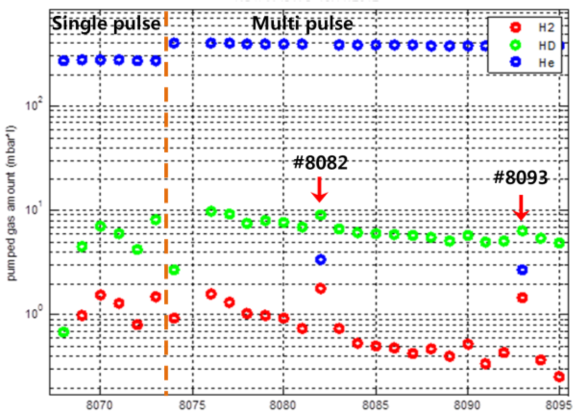

Fig.4. H_2 change amount by RGA

Fig.4. shows how ICWC shot is conducted. The single shot is made once a 1second. The multi shot is during 1minute as 6 times shots and it has interval of 9 second. And it shows that levels of hydrogen isotopes are decreased after the series of ICWC pulse.

Two plasma shots, #8082 and #8093, are L-mode shots for quantification of the cleaning effect. Fig.6. is plasma current and line density of two L-mode plasma shots.

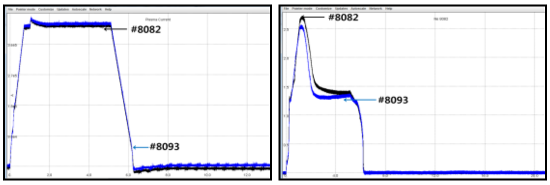

Fig.5. Plasma current and line density of shot 8082 and 8093

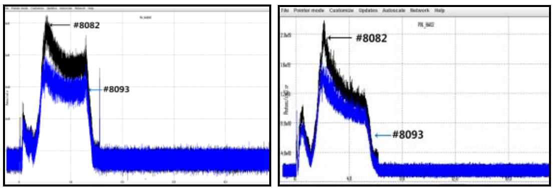

Fig.6. Comparison of channel 2 and 7 in two ICWC shot

H alpha graph shows that intensity of H alpha is reduced by 30% after the ICWC indicating the reduction of recycled H atoms from the wall.

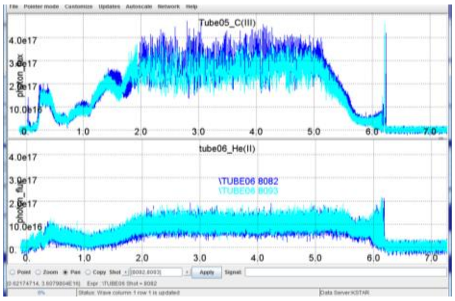

Fig.7. C(III) and O(II) change amount of filterscope

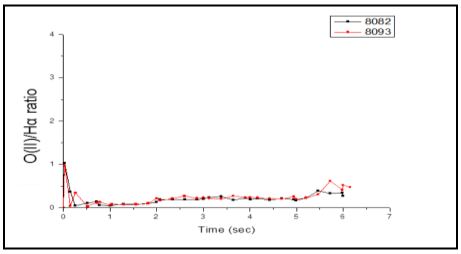

Fig.8.The impurity ratio comparison of shot 8082 and shot 8093

Impurity intensity ratio such as C(III)/Ha, O(II)/Ha in the shot 8093 is higher than that in the shot 8082 due to the H alpha signal.

4. Summary and Future works

Each experimental result shows that H-alpha intensity is decreased by 30% after ICWC and other impurity rate, such as C(III)/Ha, O(II)/Ha and He(II)/Ha is also decreased. Therefore, removal effect of impurity by ICWC was verified and ICWC is effective method for inter-shot wall conditioning.

It could be confirmed that the amount of impurities such as C(III) and O(II) was reduced due to ICWC. ICWC is effective method for inter-shot wall condition. More exact quantification of physical quantities is needed.

REFERENCES

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[2] D. S. LEE, S. H. Hong, S. W. Kim, K. P. Kim, S.H. Kim, S. J. Wang, W. C. Kim, K. R. Kim, J. K. Kwak and KSTAR Team, Ion Cyclotron Wall Conditioning (ICWC) on KSTAR, Transactions of Fusion Science and Technology, Vol.60, p.94-p.97, 2011